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BULLETIN No. 70.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

WATER-RIGHT PROBLEMS

OF

BEAR RIVER.

BY

CLARENCE T. JOHNSTON and JOSEPH A. BRECKONS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON IRRIGATION.[1]

Bul. 36. Notes on Irrigation in Connecticut and New Jersey. By C. S. Phelps and E. B. Voorhees. Pp. 64. Price, 10 cents.

Bul. 58. Water Rights on the Missouri River and its Tributaries. By Elwood Mead. Pp. 80. Price, 10 cents.

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FARMERS' BULLETIN.

Bul. 46. Irrigation in Humid Climates. By F. H. King. Pp. 27.

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[1] For those publications to which a price is affixed application should be made to the Superintendent of Documents, Union Building, Washington, D. C., the officer designated by law to sell Government publications.

MAP
OF
BEAR RIVER
SHOWING LOCATION
OF DITCHES
AND
IRRIGATED LAND

THE HORRIS PETERS CO. PHOTO LITHO. WASHINGTON D. C.

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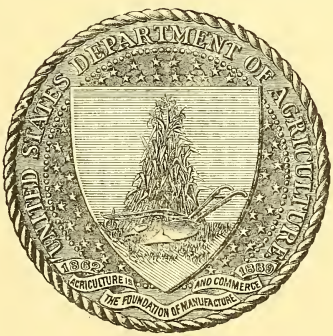

WASHINGTON:
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1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., June 28, 1899.

SIR: I have the honor to transmit herewith two papers on water-right problems of the Bear River, which runs through Wyoming, Utah, and Idaho, prepared in accordance with instructions from this Office under the direction of Prof. Elwood Mead, expert in charge of irrigation investigations. The first paper, by Clarence T. Johnston, assistant in irrigation investigations, deals with the water supply of Bear River and its diversion, and the second, by Joseph A. Breckons, discusses interstate water rights in Bear River.

These papers were prepared in pursuance of the purpose of the Office to inaugurate its study of the irrigation question by the collation and publication of information regarding the actual status of irrigation in the arid regions as regards laws, institutions, etc. Two bulletins bearing upon this phase of the subject have already been published, one (No. 58) discussing water rights on the Missouri River and its tributaries, the other (No. 60) giving an abstract of the State laws governing the appropriation of water from the same streams, with the legal forms in use in the several States forming the basin of the Missouri River.

Since few of the more important streams used for irrigation lie wholly within the limits of any one State, and there is great diversity of irrigation laws in different States, interstate complications over water rights have been frequent, and must become more frequent and more acute as the demand for water increases, unless some mode of settlement is devised.

The present bulletin is largely a statement of these interstate questions as illustrated in the Bear River Valley. This river was chosen for study because in its course of a little over 300 miles it crosses State lines (Wyoming, Idaho, and Utah) five times, finally emptying into Salt Lake, which is less than 50 miles distant from its source, thus presenting in small compass a great variety of interstate problems, and offering exceptional opportunities for the inauguration of this class of inquiries.

The bulletin is respectfully submitted, with the recommendation that it be published as Bulletin No. 70 of this Office.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Irrigation Investigations,
Cheyenne, Wyo., June 15, 1899.

Sir: I have the honor to submit herewith a discussion of the "Water-right problems of Bear River," by Clarence T. Johnston and Joseph A. Breckons.

The underlying purpose of this bulletin is to present some of the water-right complications of interstate streams. Bear River exhibits an unusual number of these in concrete form. A simple statement of its conditions brings out more clearly than any abstract discussion the problems which a disregard of drainage lines in the establishment of State boundaries has created.

For the past ten years people in Wyoming who use water from this river for purposes of irrigation have been clamoring for an establishment and protection of their rights according to the State laws. They have complied with its terms, paid the recording fees, made and filed maps to show the location of ditches and land reclaimed; but all to no purpose. The man who has paid no attention to the State irrigation code fares as well as the one who has fulfilled all its requirements. The State irrigation authorities have determined the priorities and amounts of appropriations on contiguous State streams, and water commissioners protect these in times of scarcity. They can do nothing for the irrigators along Bear River. So far as practical results are concerned the State laws do not apply. It is useless to determine priorities of ditches wholly within the State, when later ones with head gates across the border in Utah can not be closed because the water commissioner's authority does not extend that far. To close down the ditches around Evanston, Wyo., would not add to the water supply of the earlier Wyoming appropriators 35 miles north of there; it would simply raise the water level of the Utah ditches which irrigate Woodruff Flats. A determination of priorities along two sections of a stream, with an intervening section left undisturbed, would accomplish no useful purpose; hence the Wyoming irrigation authorities have delayed an adjudication until some provision is made for including head gates on the Utah as well as on the Wyoming side of the boundary. Nor is the plight of Utah irrigators in the Woodruff Valley any more satisfactory. As the

Yellow Creek and Hilliard ditches in Wyoming are extended they see later rights taking more and more of their water supply, and while both States recognize the superior claim of a prior user, lack of concerted action causes his claim to be ignored.

It is unfortunate that the future importance of irrigation was not recognized when State boundaries were being established. A change of 500 square miles either way would have disposed of the interstate problems of Bear River. It would have thrown all the controverted portion of the stream into either Utah or Wyoming. There are scores of similar instances along the boundaries of these and other arid States. The re-forming of these boundaries is now practically out of the question, but the enactment by the different States of uniform irrigation laws, and the entering into amicable agreements for the protection of irrigators' rights, are not only possible, but ought to be among the early results of the evolution now taking place.

The most effective means of promoting this is to study and give publicity to the facts. The discussion by Mr. Breckons of the change in property rights in this river the moment its waters cross an invisible barrier can scarcely fail to lead in the near future to a less violent difference in the laws which govern these rights.

The description of physical conditions by Mr. Johnston will have a local value in relieving anxiety on the lower part of the river by showing that there is no danger of diversions above creating a disastrous scarcity below; in removing the interstate jealousy by showing that the contribution of each State to the river's supply has an approximate relation to the ultimate use in that State; and by showing that relief from existing evils can be had by improving the remarkable opportunities for storage rather than through litigation over the natural flow.

Respectfully,

ELWOOD MEAD,
Irrigation Expert in Charge.

Dr. A. C. TRUE, *Director.*

CONTENTS.

	Page.
WATER SUPPLY OF BEAR RIVER AND ITS DIVERSION. BY C. T. JOHNSTON	9
Water supply	9
Character of the supply	10
Importance of subterranean water supplies	10
Measurements of the discharge of Bear River	11
Bear Lake	12
Former condition of Upper Bear River	13
Location and character of the irrigation works along Bear River	14
"Hilliard Flats"	15
Yellow Creek	15
Changes in river channel	16
"Woodruff Flats"	17
Beckwith Ranch	18
Wyoming and Idaho ditches	18
Cache and Gentile valleys	18
Bear River Canal	19
Claims to water from Bear River and tributaries in Wyoming	20
The irrigated and irrigable lands	24
INTERSTATE WATER RIGHTS IN BEAR RIVER. BY J. A. BRECKONS	26
Introduction	26
Importance of irrigation	26
Interstate controversies	27
Need of uniform irrigation laws	27
Abrogation of riparian rights	28
Origin of the doctrine of appropriation	29
Principles which govern appropriations of water	30
Interstate water-right controversies	30
Difference between water-right records in States concerned	31
Difference in character of rights	33
Difference in tribunals which determine rights	33
Evils of litigation over water rights	34
Case of Howell *v.* Johnson	35
Need of closer approach to uniformity in State laws	38
National legislation	39
Convention to consider uniform laws	39

ILLUSTRATIONS.

Page.

PLATE I. Map of Bear River, showing location of ditches and irrigated land ..... Frontispiece.

II. Fig. 1, "The Turnpike," north shore of Bear Lake, Idaho; fig. 2, southern shore of Bear Lake, Utah; fig. 3, western shore of Bear Lake on Utah-Idaho line 13

III. Bear River, near southern boundary of Wyoming 14

IV. Fig. 1, cattle ranch near Evanston, Wyo.; fig. 2, ranch 15 miles south of Evanston, Wyo.; fig. 3, farm 10 miles east of Woodruff, Utah 16

V. Fig. 1, dam for Otter Creek Canal, Utah; fig. 2, dam for Beckwith Canal, Wyoming; fig. 3, dam for Wyman and Irwin canals, Wyoming; fig. 4, dam for Bear River Canal, Utah..... 18

VI. Fig. 1, Bear River Canyon, Utah; fig. 2, plank flume, Bear River Canal; fig. 3, tunnels and retaining walls, Bear River Canal; fig. 4, flume across Malad River, Bear River Canal 19

VII. Rock cut 97 feet deep, Bear River Canal..... 20

VIII. Tunnel and wasteweir, Bear River Canal..... 20

IX. Fig. 1, Bear River Canal, looking north, showing drop; fig. 2, iron flume across Malad River, Bear River Canal..... 20

WATER-RIGHT PROBLEMS OF BEAR RIVER.

THE WATER SUPPLY OF BEAR RIVER AND ITS DIVERSION.

By Clarence T. Johnston.

WATER SUPPLY.

The use of the water in Bear River for irrigation has given rise to some water-right questions which have made it one of the noted streams of the arid region. Another claim to distinction is the fact that it is the largest stream emptying into Great Salt Lake, and the largest river in the Western Hemisphere whose waters do not reach the ocean.

From its source in the mountain lakes of Summit County, Utah, to where it empties into Great Salt Lake in the same State, the river is over 300 miles long. In that distance its fall is over 1 mile, and the 300 miles of its course finally end in its discharge into a lake less than 50 miles from its source. Its head waters could reach Salt Lake much more readily by way of the Weber, and their diversion into this stream has been several times under consideration. If this should occur, another complication would be added to those already existing. Another peculiar fact is that its source in the Uinta Mountains, its mouth at Great Salt Lake, and its most northerly bend in Idaho form the three points of an isosceles triangle, the base of which is 140 miles long and the other sides each 90 miles. The map of the river (Frontispiece) shows its remarkable affinity for State boundaries. Within the first 100 miles of its course it manages to cross the western and southern boundaries of Wyoming four times. In its entire course these boundary crossings divide the stream into six sections. Ditches heading in each of these sections are practically independent of irrigation laws or the superior claims of appropriators of water below.

Beginning at the head, it crosses the Wyoming-Utah line 9 miles east of the southwest corner of Wyoming. Just below the State line a proposed ditch is to return the water to Utah through the channel of Yellow Creek. Ditches taken out south of the Wyoming border pay no attention to prior rights north of it; their head gates stay open, even if the head gates of earlier ditches front on a dry channel. For the next 38 miles Wyoming irrigators have control of the river, after which it

deserts them by returning to Utah. The bend on the western side of the boundary is 22 miles long, in which distance Utah head gates are numerous. The stream then turns to the east and again enters Wyoming to receive a number of tributaries from the Salt River range, which more than replace all the water diverted above. The length of this last Wyoming section is about 25 miles, and it extends north of the northern boundary of Utah, so that, when the river turns west again, it enters Idaho.

The Idaho loop has two interesting features—the automatic regulation of floods by Bear Lake and the abrupt bend of the river when almost across the divide into the drainage basin of Snake River, where it cuts through a lofty range to enter Cache Valley, Utah. At the southern edge of Cache Valley it becomes again a picturesque river, roaring and tumbling through a mountain canyon, where it cuts through the range which separates Cache and Salt Lake valleys. In the 2 miles of its passage through this canyon the total fall is about 160 feet.

CHARACTER OF THE WATER SUPPLY.

If all of the water supply came from the mountains at the head there would be in effect six independent sets of claims to supply, and controversies over the diversion of the water would long ago have become acute. But this is not the case; the stream grows from the lake where it starts to the larger one where it ends. While irrigators in each of the six sections take something from the river, there are tributaries which reenforce it. As a result, the maximum measured discharge at Evanston, Wyo., of 950 cubic feet per second, becomes over 10,000 cubic feet per second at Collinston, Utah. Smiths Fork, which rises in Wyoming and empties into the stream in the last section in that State, carries a much larger volume than the main stream above their junction. Logan River adds more to its volume than all the appropriators in Wyoming can divert. Henrys Fork is an important feeder, and Bear Lake and the streams which drain into it afford a material increase to its low-water discharge. The exceptional increase due to these tributaries and the facilities for storage practically restrict interstate complications over rights to the four upper sections along the boundary between Utah and Wyoming. This progressive increase in volume is one of the complications which will vex those who attempt to frame a code of laws for the interstate division of streams. On Bear River there is not one, but a dozen important sources of supply, the volume and availability of which will have to be considered. Wyoming and Utah are the important contributors to and depleters of the stream. But little water is either added to or taken from it in Idaho.

IMPORTANCE OF SUBTERRANEAN WATER SUPPLIES.

The value and availability of a river can not be measured by a gauging at any point in its flow nor by a measurement of its surface supply.

Its gains and losses from subterranean sources are much more important than have heretofore been supposed. Thus 40 miles east of Bear River is a stream which in 10 miles loses in the rocks of its channel more water than Bear River carries during nine months of the year. In Bear River, on the contrary, there is a marked gain from seepage and the probable presence of unlocated springs which rise in the river's bed.

MEASUREMENTS OF THE DISCHARGE OF BEAR RIVER.

In September, 1898, the writer made a personal examination of that portion of the stream where the supply is at times insufficient to meet present needs. This included the four sections formed by the Wyoming-Utah boundary. Measurements were made to determine the loss from ditches, the increase from seepage, and the size of the several tributaries which enter the stream in this portion of its length. It was near the close of the irrigation season and at the time of least discharge—favorable conditions for examining the ditches and for locating the places of gain and loss from seepage and for measuring the amount of gain or loss.

The measurements began with a gauging of the stream's discharge above all the ditches, the place chosen being near the southern boundary of Wyoming. There was 57 cubic feet per second flowing in the stream at this point. A second gauging was made farther down, 6 miles above the point where the stream leaves the State to enter Utah. The discharge here was 43.5 cubic feet per second. Between this point and the State line two large ditches connect with the river in order to irrigate lands in Utah, the two ditches practically exhausting the stream. A gauging below the head gate showed only 3.5 cubic feet per second remaining. An examination of the map will show that for a considerable distance below this point there is no material addition to the stream from surface tributaries. If there had been no return seepage the volume left in the river would have been lost by evaporation before the bend in Utah had been traversed, but the increase in seepage below this point was quite marked. At the head of the Booth and Crocker and Randolph and Woodruff canals, which tapped the stream 6 miles west of the line, the discharge of the river was between 15 and 20 cubic feet per second. The first of these canals diverted about 8 cubic feet and the last about 9, leaving about 5 cubic feet per second remaining in the stream. For the next 22 miles there was no perceptible gain from seepage or other source, the river remaining practically unchanged until the mouth of Smiths Fork was reached. A gauging made immediately below the confluence of these two streams showed a discharge of 213.67 cubic feet per second. The discharge of Smiths Fork was 210 cubic feet per second, or nearly four times the flow of Bear River above all ditches. Smiths Fork drains a larger and higher mountain area than does the main stream at its head, and those familiar with both streams

agree that its flow is much larger and continues much later in the season than does that of Bear River. Continuing northward, just beyond where Bear River leaves Wyoming to enter Idaho, is the mouth of Henrys Fork. This stream at the time of the measurements was drained by the ditches above, and no water was coming from it directly, but undoubtedly Bear River receives a considerable increase from the seepage water which drains into its channel from the ditches supplied from Henrys Fork.

The next tributary below this is the slough which drains Bear Lake. This is a sluggish stream about 18 miles long, which, for a considerable portion of its course, winds its way through a marsh of cat-tails and flags. The difference between the mean elevation of Bear River and of Bear Lake is only about 2 feet, so that when Bear River is high the current is toward Bear Lake, and the flood waters of the upper river discharge into the Lake. Later on, when the stream gets low, the current reverses its direction. This causes Bear Lake to be in effect a regulator of the river, receiving its floods and augmenting its low-water discharge.

There are no important tributaries in Idaho. A few small streams, which rise in foothills rather than mountains, help to augment its flood discharge, but do little to increase the water supply for irrigation when most needed.

The largest tributary in Utah is Logan River, which joins the Bear near the southern end of Cache Valley. This is an important river, carrying fully twice as much water as the main stream at Evanston, Wyo., and probably a larger volume than Smiths Fork, the principal Wyoming tributary. Malad River also empties into the Bear in Box Elder County, Utah, but as the junction is below all ditches the increase from this source has no influence on irrigation.

BEAR LAKE.

The value of every river for irrigation is not determined by its flood discharge, but by the continuance and availability of the water supply throughout the irrigation season. On most rivers of the northern half of the arid region there is an insufficient supply for the last half of the irrigation period, and storage has to be resorted to in order to provide for this scarcity. In this respect Bear River has exceptional advantages. In addition to the lakes at its head, which can be made to hold a large part of the spring floods which now run to waste, it has in Bear Lake one of the most valuable natural reservoirs to be found within the limits of the arid region. This lake lies in both Utah and Idaho, about one-half of the lake being in each State. Its extreme length from north to south is about 20 miles, its maximum width 7.5 miles, and its approximate area 125 square miles or 80,000 acres. Its southern shore is bounded by a range of foothills, which slope gradually to the margin of the lake. On the east, hills rise abruptly from the edge of the water to a height of nearly 1,000 feet.

FIG. 1.—THE "TURNPIKE," NORTH SHORE OF BEAR LAKE, IDAHO.

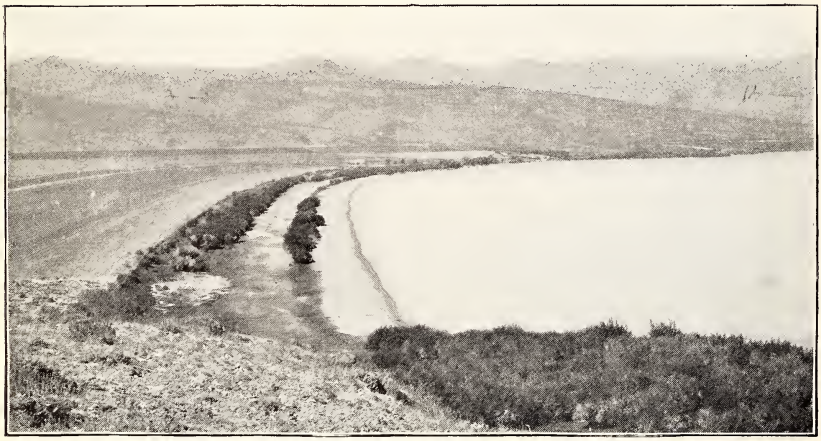


FIG. 2.—SOUTHERN SHORE OF BEAR LAKE, UTAH.

FIG. 3.—WESTERN SHORE OF BEAR LAKE, ON UTAH-IDAHO LINE.

At the north end of the lake are the lagoons and marshes which border its outlet, and which extend toward Bear River a distance of 6 or 7 miles. Between these marshes and the lake proper is a narrow and almost level ridge of sand, known locally as "The Turnpike" (see Pl. II, fig. 1), which extends from the hills on one side of the valley which the lake fills to the hills on the other. About half way across this separating ridge, which is in effect a natural dam, is the outlet of the lake, a channel which connects Bear Lake and the marshes. This channel is only 38 feet wide, and all that is required to convert Bear Lake into a reservoir is the building of a set of head gates to regulate the discharge of water, and the raising of the low places in "The Turnpike" throughout the 2 or 3 miles of its length. If this were done a rise of 5 feet in its water level would add over 400,000 acre-feet[1] to the low water supply of irrigators below. It is doubtful if the streams which empty directly into Bear Lake would furnish this, but an additional supply could be secured by the construction of a ditch from Bear River emptying into the lake. This would not have to be more than 15 miles long, and it could be made large enough to divert practically the entire discharge of the river for March, April, and May of each year.

The waters of the lake reach Bear River about 18 miles from the outlet. The river runs within 12 miles of the lake, but at the nearest point it has thrown up a low ridge along its southern bank (Pl. II, fig. 2), which prevents the river flowing into the lake basin. Judging from the water marks along the hills bordering the valley, the lake at one time covered the entire area and was between 40 and 50 miles long and from 50 to 100 feet deeper than it is at the present time. Its subsidence has left large fertile areas along the north and west shores (Pl. II, fig. 3) of the present lake. On the south there is also considerable farming land, irrigated from small creeks. Numerous small streams enter the lake from the west and serve to irrigate a considerable portion of the tillable lands on that side. This side of the lake is now an almost continuous orchard, where twenty years ago an attempt to raise even the hardiest cereals was considered a hazardous undertaking.

Nothing has as yet been done toward the improvement of this lake, the reason being that it is below the section of the stream where a scarcity has as yet been experienced. To forestall litigation reservoirs will have to be built at the headwaters of the stream. There are a number of lakes south of the Wyoming line, but no examination was made to determine either their capacity or the cost of their improvement.

FORMER CONDITION OF UPPER BEAR RIVER.

The old water levels marked on the hills bordering the valley of Bear River make it manifest that Bear Lake is the last remnant of a chain of lakes which formerly extended along the river to the southern

[1] An "acre-foot" of water is the volume required to cover an acre of land to a depth of 1 foot, or 43,560 cubic feet.

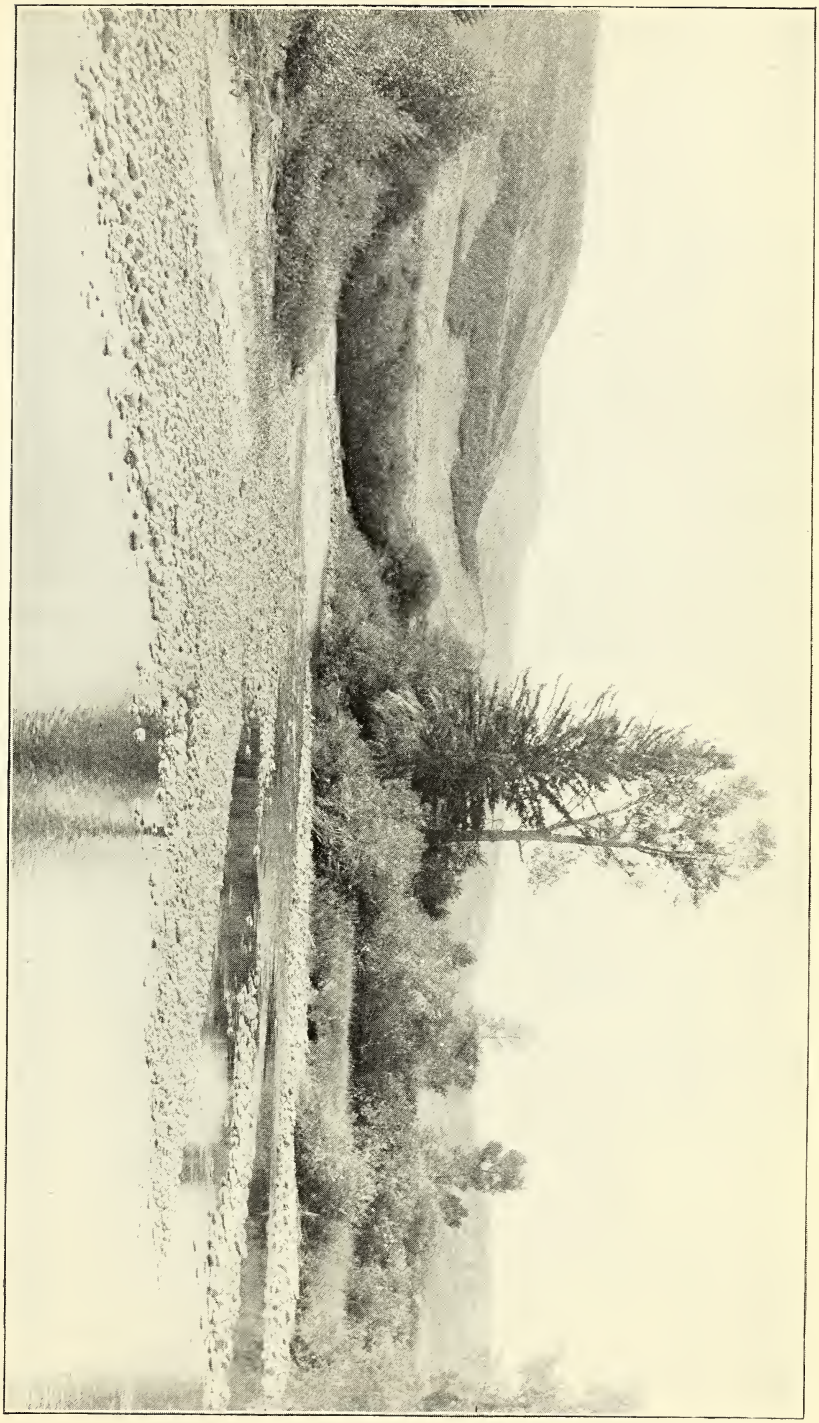
boundary of Wyoming (Pl. III). Two causes have operated to destroy these lakes—the river has lowered their line by cutting down their outlet, while the sediment carried down from above has filled the basins. Bear Lake has been saved from being filled with sediment by the low ridge which lies between it and the river. The former location of these lakes can be easily traced out by the broad and level alluvial deposits through which the stream winds its sluggish course. The first lake was located about 12 miles south of Evanston, Wyo., near the southern boundary of the State. It had a length of nearly 10 miles and an average width of 2 miles. Below it is a canyon, known locally as "The Narrows," where the river has a very rapid fall, and the indications are that at one time there was either a rapid or a cascade in the channel at this point. The second lake began near the mouth of Sulphur Creek and reached to the second canyon. This had a length of 22 miles and an average width of nearly a mile. The canyon at this point is not worn so deep, proportionately, as the one above, and for the entire distance there is not, except during high water, a ripple in the current of the river. The third and largest lake basin begins below "Narrows No. 2," and spreads out on either side of the present river channel from 2 to 14 miles. It has a length of over 50 miles. That these level bottoms were formerly basins which have been filled to a great depth with sediment is clearly evident. In the midst of these level plains are isolated points, the summits of what were once high foothills. They stand out like islands in the ocean, all but the summits having been submerged in the river's deposit and glacial drift from above.

LOCATION AND CHARACTER OF THE IRRIGATION WORKS ALONG BEAR RIVER.

The 100 miles of Bear River above the mouth of Smiths Fork is the portion which has been productive of water-right complications. Here in August the demand for water often exceeds the supply. The ancient lake beds above described are fertile and easily reclaimed, and the number of ditches built to water them is indicated by the fact that there are 150 recorded in the Wyoming State engineer's office alone. Adding to these the number built to water Woodruff Flats, in Utah, there must have been in September, 1898, over 200 claims to the 47 cubic feet of water per second which crossed the southern boundary of Wyoming. Nearly all these are small individual ditches less than a mile in length. They are not shown on the map, because the scale used was not large enough to permit of locating the head gates, much less to draw the lines of the ditches.

The country irrigated is in the midst of an extensive grazing area used by the owners of range flocks of sheep and herds of cattle, and the growing of winter feed for live stock is the leading industry.

The river rises among the loftiest peaks of the Uinta Range, amid picturesque scenery in which deep snow-filled canyons and a number



BEAR RIVER, NEAR SOUTHERN BOUNDARY OF WYOMING.

of glacial lakes are the chief attractions. When it leaves these it emerges into a broken foothill country which is partially covered with pine timber. Much of this region has been devastated by fire. In many places aspen groves have sprung up where blackened tree trunks would otherwise mark the vanished forests of pine. The removal of the timber in this broken country has destroyed the natural reservoir system of Bear River. Formerly the snow lingered late, and springs were abundant on the hillsides, but conditions have so changed that artificial reservoirs are now being discussed. The foothills extend almost to the Wyoming line, where they break away as the river turns to the northwest. The channel of the stream follows close to the hills on the west side for 7 or 8 miles below the line. On the east side a low, flat divide runs to Mill Creek, the first tributary of Bear River on the east. This divide is a mass of water-worn pebbles and bowlders, and the entire area is covered with a dense growth of sagebrush. Ditches tap Bear River near the boundary and cross the Mill Creek divide at almost right angles to the main stream. There is more cultivated land along Mill Creek than along Bear River above their junction.

"HILLIARD FLATS."

Two ditches cross both the Mill Creek watershed and a second divide to irrigate land along Sulphur Creek. This land is known locally as "Hilliard Flats." It is separated from the valley of Bear River by a high range of hills. These break off on the south, thus allowing water to be carried into the valley at small expense. The area capable of being irrigated approximates 8,000 acres, and water can be easily distributed over the entire area. The southern half of the valley is settled, although not over one-tenth of the irrigable land is cultivated. The soil varies; along the hills on both the eastern and western borders it is the black loam often seen in mountain valleys; through the center of the valley, running north and south, is a gravelly ridge well adapted to cereals and forage crops. Sulphur Creek follows along the east side of the valley. It is of little importance as a source of water supply, as it furnishes but a small quantity at any time in the year. The older residents of the valley all state that before the timber on the head waters of the creek was destroyed it maintained a large and perennial flow.

YELLOW CREEK.

There is a somewhat similar valley on the west side of Bear River along Yellow Creek. A canal has been surveyed to carry water over the divide between the river and this tributary. The line follows the river for some distance along an almost vertical bank. It is but little longer than the Hilliard Flats ditch, but more expensive. The area capable of being irrigated approximates 12,000 acres, and is distributed along the creek for 15 miles. The estimated cost of this ditch is $4,000.

Along the river, near the mouth of Mill Creek, the ground is saturated with alkali, and greasewood takes the place of sagebrush. The presence of this salt has thus far discouraged attempts to utilize land in that vicinity. However, alkali disappears below the mouth of Mill Creek. For 4 or 5 miles from this point the valley is a mile and a half wide. Natural grass meadows, interspersed with alfalfa fields, extend from one side of the valley to the other. Five miles below the mouth of Mill Creek the valley becomes narrower, and there are no more farms until within 3 miles of the mouth of Sulphur Creek, where it again widens to three-fourths of a mile. This place is referred to as "Narrows No. 1." From here to the mouth of Yellow Creek the valley of the river is narrow.

CHANGES IN RIVER CHANNEL.

In the vicinity of Evanston, or about a mile above the mouth of Yellow Creek, the meadows bordering the river are cut in every direction by old channels. Some of these channels are dry except at high water; others are used as ditches, while a third class carry some water all the time and are a source of uneasiness and loss to the owners of the land through which they run. In high water they tend to alter the main channel of the river, and thus imperil the crops and ditches below them. One of these channels begins about 2 miles above Evanston on the east bank of the river. Ditches are taken from it wherever convenient. Some are but plow furrows a few hundred feet long, while others are half a mile in length. During the flood season this waterway is beyond control. All the ditches diverting water from it are filled to overflowing, and the meadows are saturated continuously until low water. It has divided into three sloughs opposite the town of Evanston, each of which is bridged on the country road.

At the junction of Bear River and Yellow Creek the river turns to the north. The valley from there to the second narrows, 4 miles from the Wyoming-Utah line, approximates a mile in width. The entire irrigated area from 7 miles below Evanston to these narrows is controlled by a few ranchmen (Pl. IV, figs. 1 and 2). The valley is a continuous meadow. The ditches are larger and are kept in better repair than those farther up the stream.

The scarcity of head gates to ditches is a characteristic feature of Bear River irrigation works in Wyoming. Another is the parallel construction of ditches to water land below all of them. On the west bank of the river, opposite the mouth of Sulphur Creek, are the heads of four ditches. There are places along them where all are in view on the same hillside. Each ditch above is a menace to all below. The extent of damage occasioned by a break in one depends on how many are below and how much water each ditch is carrying. This multiplicity of parallel ditches indicates a lack of cooperation among farmers not met with in either Idaho or Utah.

FIG. 1.—CATTLE RANCH NEAR EVANSTON, WYOMING.

FIG. 2.—RANCH 15 MILES SOUTH OF EVANSTON, WYOMING.

FIG. 3.—FARM 10 MILES EAST OF WOODRUFF, UTAH.

Three miles below Evanston the Chapman Canal begins. It is the most important canal along the river in Wyoming, although of the 47,680 acres of land it irrigates but 10,088 lie in that State. The canal was measured a short distance below its head gate. It is 18 feet wide on the bottom, 24 feet wide on the top, and 4 feet in depth, with a grade of 3 feet per mile. These dimensions give a carrying capacity of approximately 252 cubic feet per second. The ditch is well constructed, although it follows the contour of the ground too closely for a channel of its dimensions. Each irregularity in the surface of the ground has a corresponding curve in the ditch. This not only detracts from its appearance, but adds much to the erosion of the banks.

"WOODRUFF FLATS."

Immediately below the second narrows the river crosses into Utah and at once widens. This valley is locally known as the "Woodruff Flats." The Woodruff Flats extend to the south for 12 miles, and as the river turns to the north the valley has a width varying from 4 to 7 miles until the river returns to Wyoming, where the valley becomes much narrower, being but little over a mile in width. The land reclaimed in Utah is irrigated by larger canals, and the methods of the farmers are much superior to those followed in Wyoming, either above or below this tract. (Pl. IV, fig. 3.)

Four miles below the narrows the Randolph and Woodruff Canal connects on the west side of the river. This canal is 24 feet wide on top, 20 feet wide on the bottom, and 4 feet in depth. For the first 3 miles it has a fall of 30 inches per mile. The grade decreases below this to 20 inches per mile, which fall is maintained to the end. It has a carrying capacity for the first 3 miles of 220 cubic feet per second and for the remainder of the distance of 114 cubic feet per second. The local theory for having the greatest fall at the head of the ditch and decreasing it as the cross section diminishes is that when water is once started in a ditch the quantity can be held. The ditch is thus regarded as a species of funnel. That this practice is wrong is evident from the appearance of the channel at the upper end of the canal. A fall of 30 inches per mile is too great, and the channel has washed wherever the material is anything but solid rock or gravel. The material washed out must be deposited along the lower part of the canal, where the current is not swift enough to carry the sediment. The canal covers a valuable tract of land averaging 4 miles in width, a large portion of which is now under cultivation. Oats, wheat, rye, and garden products are the principal crops, but the cultivation is superior to that seen on the stock ranches found above in Wyoming. Considerable land is irrigated below Randolph from the same canal.

On the east side of the river is the Booth and Crocker Canal, 20 feet wide on top and 2 feet deep, which irrigates a narrow strip of land lying between Bear River and the Bear River Mountains. This canal

is 20 miles long. Near its terminus the Otter Creek Canal connects with the river on its west bank. It irrigates a large area of natural meadow land. It is 30 feet wide and 3½ feet deep. (Pl. V, fig. 1.)

BECKWITH RANCH.

The Beckwith Company has three ditches. The first of these connects with the river on the west side, 6 miles above the Wyoming line. It is 30 feet wide on top, 25 feet wide on the bottom, and 4 feet deep. The other two canals of this company leave the river 2 miles below the Wyoming line. The most expensive dam on this section of the stream serves to raise the water to fill these canals. (Pl. V, fig. 2.) The ditches have no head gates. The dam has regulating gates which can be closed and the level of the river raised to flow into the canals. The dam is a rock-filled crib structure, having a roadway built over the cribs and large quantities of loose rock thrown in above them. The gates are placed on the upper side of the dam and are so arranged as to be worked by one man.

WYOMING AND IDAHO DITCHES.

The valley of the river from this point to the junction of Bear River and Smiths Fork has an average width of 1½ miles. Immediately below the confluence of the two streams are the third narrows. The Wyman and Irwin canals begin below them. Like the Beckwith canals, one dam suffices for the two and no head gates have been constructed. (Pl. V, fig. 3.) Numerous small ditches have been built between these canals and Bear Lake Valley. Henrys Fork flows into the main stream from the north beyond the Wyoming line. Here the valley of the river is from 2 to 4 miles wide, but it becomes narrower just below and contains little irrigable land until Bear Lake Valley is reached. In this valley the four ditches taken from the stream serve to irrigate 16,000 acres. From Bear Lake Valley, Idaho, to the Cache Valley, in Utah, the hills approach close to the river, and only a limited area can be reclaimed.

CACHE AND GENTILE VALLEYS.

Some 15 miles below Soda Springs several small tributaries furnish water for the irrigation of a tract of land known as Gentile Valley. The land is rolling, and many of the hillsides are under cultivation. But one ditch is taken from the main stream, and it only serves to irrigate a small area of bottom land. The river is in a deep channel and the grade is light, thus making it almost impossible to take water from it by canals without the construction of a high and expensive dam at the head.

Cache Valley is chiefly irrigated from the tributaries of Bear River. Of these Logan River is the most important, although Cub Creek, Blacksmith Fork, and Box Elder Creek furnish water for large tracts.

PLATE V.

FIG. 1.—DAM FOR THE OTTER CREEK CANAL, UTAH.

FIG. 3.—DAM FOR THE WYMAN AND IRWIN CANALS, WYOMING.

FIG. 2.—DAM FOR THE BECKWITH CANAL, WYOMING.

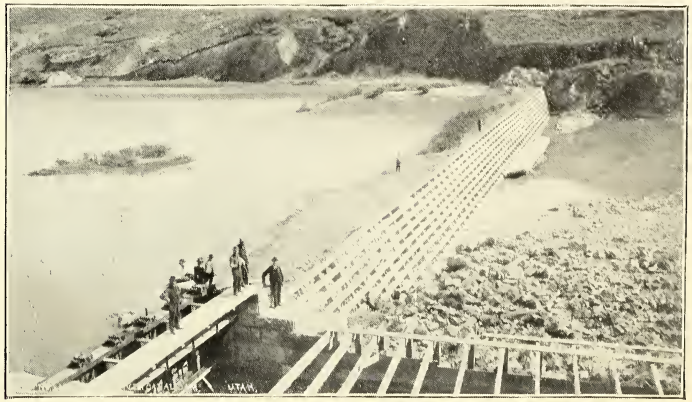


FIG. 4.—DAM FOR BEAR RIVER CANAL, UTAH.

U. S. Dept. of Agr., Bul. 70, Office Expt. Stations.

U. S. Dept. of Agr., Bul. 70, Office Expt. Stations

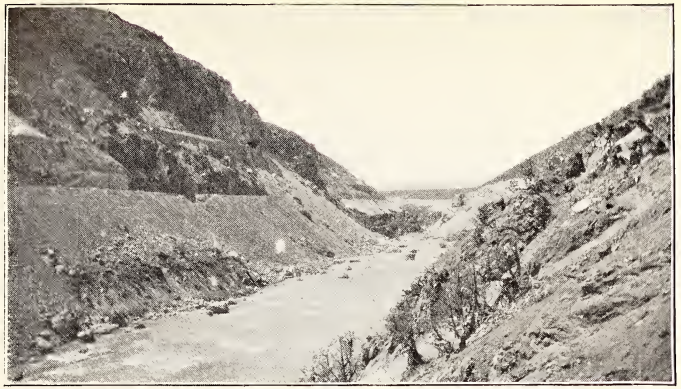


FIG. 1.—BEAR RIVER CANYON, UTAH.

FIG. 3.—TUNNELS AND RETAINING WALLS ON BEAR RIVER CANAL.

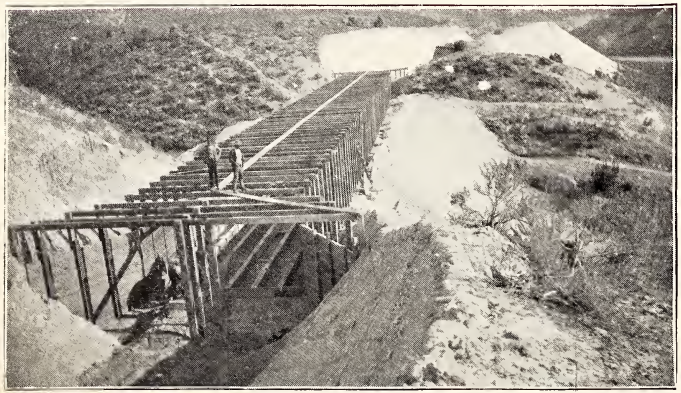


FIG. 2.—PLANK FLUME ON BEAR RIVER CANAL.

FIG 4.—FLUME ACROSS MALAD RIVER, BEAR RIVER CANAL.

This valley is known as the granary of Utah, and well deserves the name, as more grain is grown here than on any other one tract in the State. The water of the streams is used to the best advantage, and a large amount of money and labor has been expended in the construction of reservoirs. Newton Reservoir is the most important of these. It has a capacity of nearly 900 acre-feet.

BEAR RIVER CANAL.

Immediately below the junction of Logan River and Bear River, Bear River Canyon (Pl. VI, fig. 1) begins. At the upper end of this canyon are the diverting dam and head gates of the Bear River Canal (Pl. V, fig. 4), one of the most notable examples of canal engineering to be found on this continent. This canal (Pl. VI, figs. 2 and 4) is notable both for its size and for the excellent and enduring character of its construction. The temporary makeshifts which were a marked feature of the earlier irrigation works have here been discarded and in their place are enduring structures of masonry and iron. No recent work has more strongly marked the tendency toward greater durability and firmness than the works of this canal. The head gates are of iron and rubble masonry; the waste gates and regulating gates all have iron frames. The largest flume on the canal has an iron truss support, and a smaller flume is built entirely of iron—the first, it is believed, to be built in the United States. The following description of this system is taken from a paper read before the American Society of Civil Engineers soon after the work was completed:

A fine example of the present stage of canal development, and one which has been designed and constructed under the supervision of some of the best irrigating engineers, is the Bear River Canal, in Utah, which is diverted from the Bear River at a point about 3.5 miles above Collinston. This system consists essentially of a main western and main eastern canal, diverted one from either bank, while the former is divided into two principal branches, from which are taken the various laterals supplying the private ditches. At present there are completed the diversion weir and the first 6 to 8 miles of heavy rock in the canyon which brings the water to the level of the broad valley lands which it is intended to irrigate.

The average minimum discharge of Bear River at the weir site is about 1,000 second-feet, occurring in midsummer, while the maximum recorded flood discharge is less than 9,000 second-feet. The diversion weir is admirably located between two high rock abutments and with shallow rock foundation. It is constructed of crib work filled with earth and loose stone, having a total height of 16.5 feet and a length at the bottom parallel to the channel of the stream of 38 feet, its length between abutments being 370 feet on the crest. The upstream slope is 1 on 2 and the downstream slope about 1 on ½, the water falling on a wooden apron anchored to the bed rock. All timber is 10 by 12 inches and is driftbolted to the rock bed. The head gates on the west side consist of five gates, each 4 feet wide by 7 feet high, of iron, and built into substantial masonry-in-cement abutments and piers founded on rock. The head gates to the eastern side canal are of essentially similar form of construction.

The first 2 miles of the east side canal are in heavy rockwork, in which are two tunnels, the first being 423 feet long and the second 200 feet in length. (Pl. VI, fig. 3). In this portion of the canal are a number of deep rock cuts, as shown in the accompanying

illustration (Pl. VII), the greatest of which is 96 feet in height on the upper side, while in numerous places the lower side of the canal consists of a built-up retaining wall of rubble masonry cement, usually 10 feet in height inside, with a top width of 2.5 feet, and a width at grade line of 7.5 feet. For 5 miles below the rockwork the canal is excavated in steep earth hillsides, the slope of which is about 3 to 1. After reaching the level country the east side canal has a bottom width of 50 feet, a depth of water of 7 feet, with side slopes of 1 to 1, and a grade of 1 foot per mile. This canal as projected will have a length of 50 miles, terminating at the Ogden River in the city of Ogden.

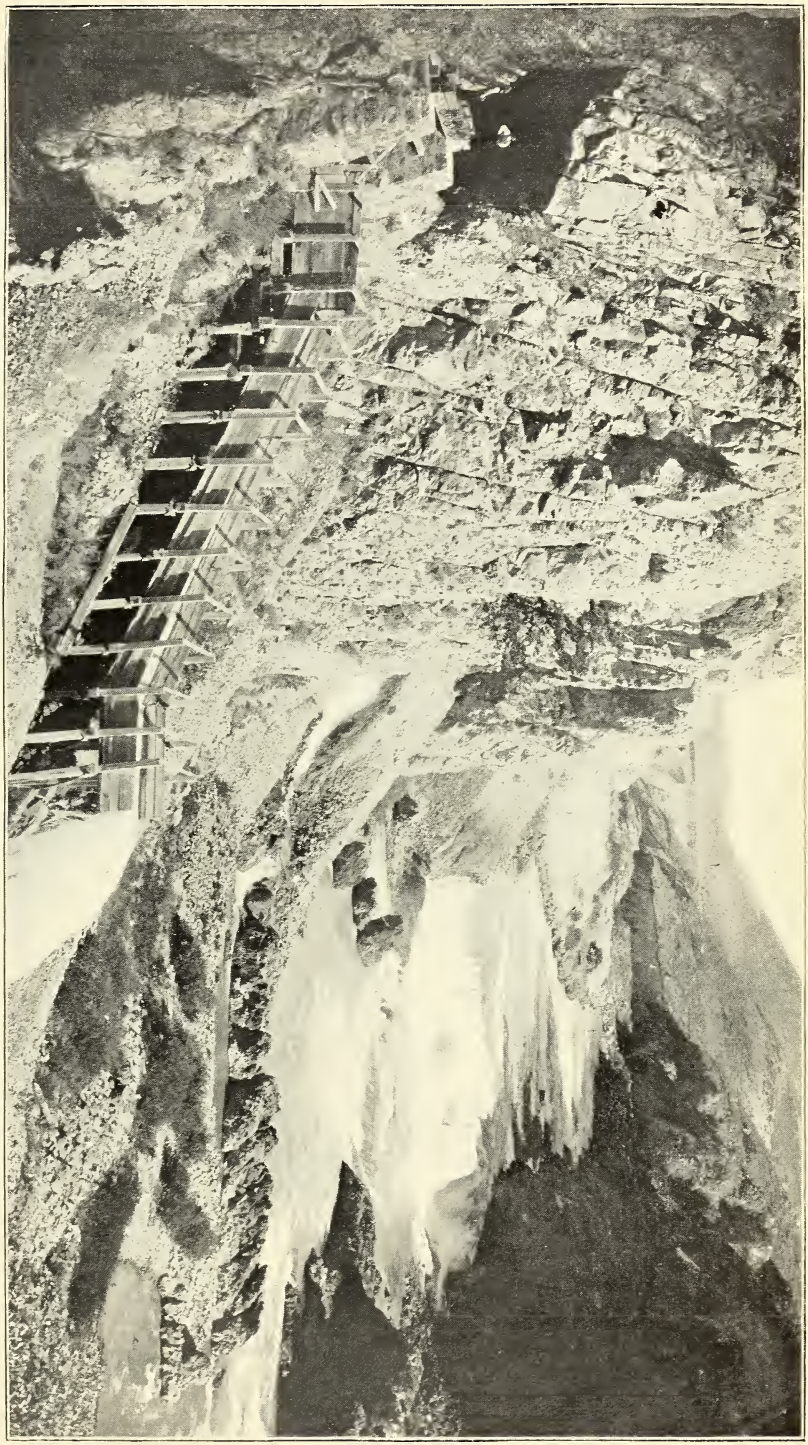
The west side canal for the first 9,000 feet of its length is likewise constructed in heavy rock canyon work. In this portion of its line are six tunnels (Pl. VI, fig. 3), varying in length from 57 to 279 feet, and having the same cross section and grade as the east side tunnels. Below and between the tunnels are eleven big retaining walls of rubble masonry, having dimensions similar to those on the east side canal, while this portion of the canal has a bed width of 14.3 feet, a depth of 10 feet, and nearly vertical slopes through the rockwork. Twelve hundred feet below the head of this canal is an escape gate, and 600 feet farther down a second escape gate, both discharging back into the river, and both having clear discharge openings of 12 feet in width, closed by three wooden gates sliding between iron posts into masonry piers (Pl. VIII). Below the second escape is a regulator closed by five gates, each 4 feet in width, by which the discharge in the canal itself is controlled. After leaving the rockwork the canal enters steep hillside excavations in earth and clay similar to that on the east side, and extending to the sixth mile. In this hillside work the bottom width of the canal is 14.3 feet, depth 12 feet, side slopes approximately 1 to 1, while there are several deep fills and cuts similar to those described for the east side. Beyond the ninth mile the canal crosses the Malad River and valley on a high iron bridge and flume, 378 feet in length and 80 feet in maximum height, supported on iron trestles, the river span of which is 70 feet. (Pl. VI, fig. 4.) This bridge has approaches by means of wooden flumes which are 500 feet long, 20 feet wide in the clear, and carrying 7 feet in depth of water, the waterway over the iron bridge consisting of a similar wooden flume. In its course the main western line has three falls, each of 7 feet in height, to lose grade, and it is projected for a length of 40 miles, terminating at the Great Salt Lake.

Six miles below the head of the west side canal the Corinne branch is diverted, which terminates in the twentieth mile of its course at the city of that name. This branch at the head is 22 feet wide at the bottom, and carries 10 feet depth of water, and is controlled at its head by a double set of regulating gates. In the main and Corinne branches the bottom and sides of the canal are well protected by wooden aprons and wings. As this branch runs down the slope of the country it has in its course sixteen vertical falls (Pl. IX, fig. 1), varying from 4 to 12 feet in height. At the fourteenth mile Malad River is crossed on a high iron bridge founded on piles and iron cylinders filled with concrete. This bridge (Pl. IX, fig. 2) consists of three principal bents from 25 to 60 feet in length, the peculiarity of its construction being that the superstructure forming the bridge itself is of iron-plate girders and constitutes the flume which carries the water.

CLAIMS TO WATER FROM BEAR RIVER AND TRIBUTARIES IN WYOMING.

The early Territorial records of Wyoming resemble those kept by the county clerks of Utah and Idaho to-day. The claims first recorded follow no special form. The name of the owner of the ditch, his post-office address, and the amount of water claimed were the features made most conspicuous. A vague idea of the value of a cubic foot per sec-

ROCK CUT 97 FEET DEEP, BEAR RIVER CANAL.



TUNNEL AND WASTEWEIR, BEAR RIVER CANAL.

FIG. 1.—BEAR RIVER CANAL, LOOKING NORTH, SHOWING DROP.

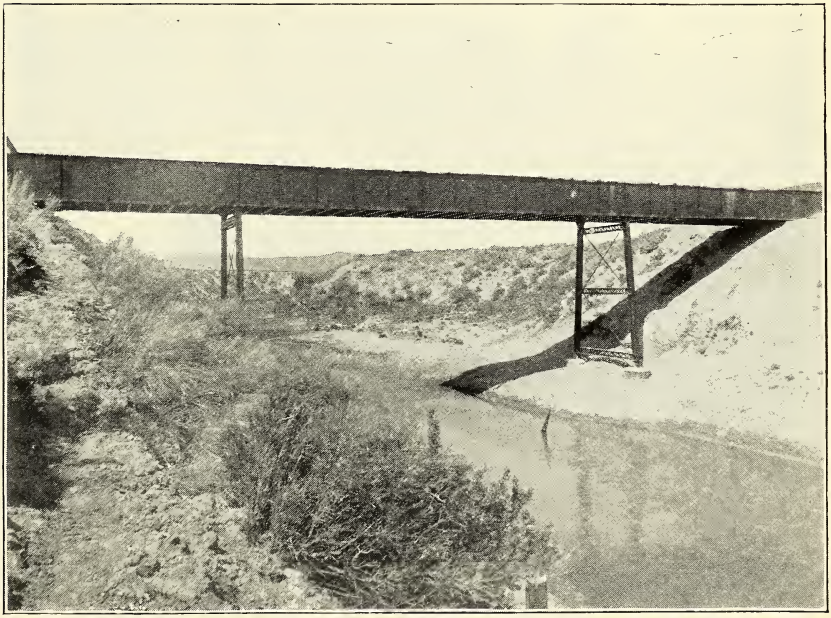


FIG. 2.—IRON FLUME ACROSS MALAD RIVER, BEAR RIVER CANAL.

ond, or miner's inch, resulted in an irrigator claiming an amount equal to the volume of the river for the irrigation of a few acres, while his neighbor might claim but a small quantity for watering 160 acres or more. The error in this particular was, however, generally on the safe side for the irrigator, and the claims on Bear River alone call for over 1,000 cubic feet per second. This volume is between three and four times as much as is needed for all the land irrigated along Bear River in Wyoming to-day.

In the Territorial adjudications, made by the courts, the carrying capacity of the ditch, instead of the area irrigated, determined the amount of the appropriation. This influenced somewhat the building of ditches as well as the form of the claims filed for record.

The State law, which has been in force since 1890, provides for a board of control, which has entire charge and supervision of the water of the State and makes all adjudications. It is made up of the State engineer and four division superintendents. The law required the county clerks to furnish the State engineer with a complete transcript of all territorial claims to water, and made the State engineer's office the place of record of all claims to water. The applications for permit under the State law correspond somewhat with the statement of claim under the Territorial law. In addition to giving the name of the owner, the dimensions of the ditch, etc., it includes a description and area of the land to be irrigated. No specific quantity of water is claimed. The application must be filed before construction is begun, and the State engineer has authority to return the paper, or map accompanying it, for correction, and to refuse permits where streams are fully appropriated. Neither the application nor the statement of claim is a title to water. Under the Territorial laws, the decree of the court was as near a title as the irrigator was able to obtain. Under the State law, the board of control issues certificates of appropriation, after the adjudication is made, which are similar to a land title and as explicit.

Under State and Territorial claims 19,840 acres of land are irrigated in Wyoming from the water of Bear River. If the State should adjudicate these rights, 283 cubic feet of water per second would be allotted to this area. The gaugings made in September, 1898, when the river was at extreme low-water stage, show the scarcity of water that would exist even if the quantities used were limited to 1 cubic foot of water per second for each 70 acres, as required by the State law. But 57 cubic feet of water per second entered Wyoming from Utah at that time. No tributary adds to this discharge until Smith's Fork is reached, which is practically on the Wyoming-Idaho line.

The tables following, taken from the State and Territorial records, give evidence of the gradual improvement in the form of the papers filed.

As before stated, only the largest ditches are shown on the map of the river (Frontispiece). The number of individual ditches is far greater. Only since 1881 have the laws of Idaho required the recording of

ditches. Utah has required it only since 1897. In neither of these States does a failure to record appropriations made prior to those years work a forfeiture of rights. Hence their records are incomplete, and the names of claimants and the amount of water claimed can not be given.

Abstract of Territorial claims to water from Bear River and tributaries in Wyoming, recorded in the office of the State engineer at Cheyenne, Wyo.

Date of instrument.	By whom signed.	Dimensions.					Amount claimed.
		Length.	Width.			Depth.	
			Top.	Bottom.	Mean.		
			Feet.	*Feet.*	*Feet.*	*Feet.*	
	John N. McElmore						
Dec. 19, 1871	David D. Colton	25,950 feet	3	2		3	720 miner's inches.
Apr. 4, 1874	Jno. W. Kerr et al						
Mar. 28, 1877	Orlando North et al						
July 8, 1878	do						
Aug. 5, 1879	Chas. Crocker et al	5 miles			2		
	John Slater						
May 6, 1881	Isaac Groo						
	O. E. Snyder						
	Anthony V. Quinn et al.				25	2	
July 11, 1881	Jas. Smith et al						
	Wm. P. Nee						
May 5, 1882	Jno. Fielding						200 miner's inches.
Apr. 12, 1892	Brigham Barnes	¼ mile	2	1½		1	1 cubic foot per second.
June 13, 1891	John Burden	1 mile	8	5		2	5½ cubic feet per second.
July 1, 1891	John B. Wilson	1,000 yards	4½	3		1	1½ cubic feet per second.
May 15, 1882	Geo. Acocks						
May 22, 1882	Jno. M. Fife				3	1	500 inches.
May 27, 1882	do						
June 2, 1882	Frank Conway						1,000 cubic inches.
Apr. 7, 1882	Wm. Spence	2 miles			3	1	100 cubic inches.
June 21, 1882	Jno. B. Wilson						
Oct. 17, 1882	Stephen A. Mills et al.	4 miles			12	2	
Oct. 30, 1882	Chas. Deloney et al						
Mar. 17, 1883	Reuben Fowkes						
Mar. 20, 1883	Stephen R. Glasscock.						
May 24, 1883	Amos Edwards						
July 19, 1883	James Bowns et al	2 miles			5	3	
July 28, 1883	Wm. Cook et al	10,054 feet			20	2	
Oct. 8, 1883	Arthur W. Sims				4	2	
May 30, 1884	Alonzo F. Sights	4 miles			20	2	
July 25, 1884	G. Christensen	1⅓ miles			3	2	
Aug. 4, 1884	Martin Christensen	500 yards			4	2	
Sept. 1, 1884	James Blight				5	3	
Jan. 16, 1885	G. Christensen	2 miles			3	1	
Nov. 5, 1884	Wm. Morris et al	3½ miles			8	2	
July 2, 1885	Wm. H. Lee	2 miles			10	3	
Aug 24, 1885	Cramer Deuel				10	2	
Oct. 20, 1885	W. H. Blanchard	1¼ miles			4	1½	
Dec. 18, 1885	John Felter				2	1	
Feb. 27, 1886	Jean Pierre Anel	½ mile			3	3	
Mar. 19, 1886	Alfred A. Mott				2	½	
Mar. 25, 1886	Chambers & Whitney.	20½ miles			8	3	
Apr. 12, 1886	A. Brown				3	2	
May 8, 1886	Thomas Baker				3	2	
May 15, 1886	Wm. Brown	1½ miles			3	1	
Do.	Enoch Turner et al.	½ mile			4	1	
May 19, 1886	Wm. Brown et al	1½ miles			3	1	
May 25, 1886	Arthur W. Sims				3	1	
May 20, 1886	Mary M. Sights				6	1½	
July 20, 1886	Reuben Fowkes				6	1½	
July 27, 1886	James McMahon	2 miles			2	1	
Aug. 7, 1886	John A. McGraw	1 mile			7	1½	7 cubic feet per second.
Aug. 13, 1886	Geo. F. Chapman et al.	7 miles	15	12		3½ 1	
Aug. 17, 1886	Saml. Knoder	1 mile	5	4			
Aug. 23, 1886	Jno. H. Whitney	9 miles			5½	1½	
Aug. 30, 1886	Luke Morris et al	500 feet	4½	3½		1½	3 cubic feet per second.
Aug. 31, 1886	June Reese	300 yards	4	3		1½	2.625 cubic feet per second.

Abstract of Territorial claims to water from Bear River, etc.—Continued.

Date of instrument.	By whom signed.	Dimensions.					Amount claimed.
		Length.	Width.			Depth.	
			Top.	Bottom.	Mean.		
			Feet.	*Feet.*	*Feet.*	*Feet.*	
Sept. 1, 1886	Chas. M. White	11 miles			10	2½	12 cubic feet per second.
Do	A. C. Beckwith et al.	5 miles	18	15		1½	8.333 cubic feet per second.
Do	do	10 miles	22	18		2½	20.833 cubic feet per second.
Sept. 2, 1886	Jno. W. Myers	1¼ miles	5	4		1	7.65 cubic feet per second.
Sept. 22, 1886	Jno. Wagstaff	2½ miles	3	2		1	5 cubic feet per second.
Oct. 18, 1886	John Fearn	200 yards	2	1½		1	1,487 cubic inches.
Sept. 23, 1886	H. H. Cook	4 miles	20	16		2	15 cubic feet per second.
Mar. 14, 1887	Jos. W. Cook						
June 22, 1887	H. N. Bodine et al	1½ miles	6	4		2	10 cubic feet per second.
June 11, 1887	Wm. H. Wyman	1 mile	20	16		2	8.5 cubic feet per second.
Do	do	do	18	14		2	Do.
Oct. 13, 1887	Jno. B. Wilson	1½ miles	3	2		1	2.5 cubic feet per second.
Mar. 8, 1888	Jno. A. Holmes	2 miles	5	4		1	4.5 cubic feet per second.
Mar. 30, 1888	Geo. F. Chapman	8 miles	16	14		2	61.20 cubic feet per second.
Apr. 2, 1888	Jno. M. Sights	1 mile	2½	1½		1	2 cubic feet per second.
June 9, 1888	Richard Irwin	1½ miles	7	5		2	12 cubic feet per second.
May 9, 1888	do	1¼ miles	2½	1½		1	4 cubic feet per second.
May 28, 1888	Frederick Coles	¾ mile	4	3		1	3½ cubic feet per second.
June 23, 1888	Robt. M. Lewis	½ mile	6	4		1½	7.5 cubic feet per second.
Sept. 3, 1888	J. N. Whitney	2 miles	6	5		2	100 cubic inches.
Oct. 4, 1888	Robt. M. Lewis	1¾ miles	7	5		1½	13.5 cubic feet per second.
Nov. 10, 1888	Chas. P. Pixley	2¾ miles	29	18		1½	25 cubic feet per second.
Aug. 21, 1886	Wm. Hinton		2½	1½		1	864 cubic inches per second.
Aug. 20, 1886	do		4½	3½		1½	1.51 cubic feet per second.
Aug. 21, 1886	do		2½	1½		1	864 cubic inches per second.
Do	do		2	1		1	2.125 cubic feet per second.
Aug. 20, 1886	do		4½	3		1½	1.125 cubic feet per second.
Aug. 21, 1886	do		5	3		2	3.333 cubic feet per second.
Jan. 24, 1889	Henry H. Stedman	1¼ miles	10	8½		1	9.25 cubic feet per second.
Mar. 4, 1889	Martin V. Morse	¾ mile	20	14		1½–8	22.5 cubic feet per second.
Feb. 26, 1889	Jno. R. Bothwell						
Mar. 30, 1889	Wm. H. Byrne	¼ mile	4	3		1	3.5 cubic feet per second.
Do	do	½ mile	1	⅔		⅔	1 cubic foot per second.
Apr. 5, 1889	Jno. B. Wilson	3½ miles	5	3		1⅛	6 cubic feet per second.
Apr. 23, 1889	Jno. R. Richards	80 rods	4	3		2	2 cubic feet per second.
Apr. 27, 1889	Wm. Crompton	1¼ miles	4	3		1½	5 cubic feet per second.
May 11, 1889	Jas. Blight	4 miles	10	8		1	9 cubic feet per second.
June 10, 1889	Jesse Knight	8,600 feet	6	5		1¼	4 cubic feet per second.
July 3, 1889	Geo. T. Dunford	600 yards	1½	1		⅔	1 cubic foot per second.
July 8, 1889	John Fife	do	1½	1		⅔	1 cubic foot per second.
Aug. 5, 1889	Wm. Garrett	1¼ miles	7	5		1	6 cubic feet per second.
Sept. 26, 1889	J. P. Anel	3½ miles	6	4		1½	5 cubic feet per second.
Oct. 15, 1889	Jas. B. Bruce	800 feet	4	3		1	3 cubic feet per second.
Nov. 9, 1889	Henry Homer	1½ miles	4	3		3	Do.
Dec. 2, 1889	Harvy Booth	6 miles	12	8		2	40 cubic feet per second.
Mar. 4, 1890	Wm. P. Nebeker	6½ miles	16	12		3	60 cubic feet per second.
Apr. 24, 1890	Oscar E. Snyder	1¼ miles	20	16		2	8 cubic feet per second.
May 22, 1890	J. C. Jacobson	1 mile	8	6		2	14 cubic feet per second.
June 3, 1890	A. G. Richards	4 miles	2	2		1	26 cubic feet per second.
Aug. 2, 1890	John Titmus	10 miles	9	7		3	24 cubic feet per second.
Nov. 18, 1890	Bear River and Yellow Creek Irrigation and Land Co.						
Dec. 19, 1890	Robt. M. Lewis	4½ miles	6	5		1½	14.5 cubic feet per second.
Feb. 6, 1891	Wm. Hinton	20 miles	20	16		2½	100 cubic feet per second.
Mar. 9, 1891	Geo. Tibbets	2½ miles	5	4		1	

Abstract of the permits to appropriate water from Bear River and tributaries issued by the State engineer of Wyoming since January 1, 1891.

Date of instrument.	By whom signed.	Dimensions.				Acres irrigated.
		Length.	Width.		Depth.	
			Top.	Bottom.		
			Feet.	*Feet.*	*Feet.*	
July 2, 1891	Geo. Tschirgi	3 miles	8	6	2	1,020 acres.
Aug. 21, 1891	Jno. L. Russell	895 feet	3	2	1½	Mining.
Nov. 27, 1891	Jonathan Jones	13 miles	10	6	2	7,040 acres.
Apr. 5, 1892	W. P. Nebeker	11 miles	15	9	3	3,520 acres.
May 2, 1892	Wm. Fearn	¾ mile	2½	2	1	60 acres.
June 5, 1893	Augustus W. Anderson	7 miles	6	4	1½	440 acres.
Aug. 28, 1893	I. C. Winslow	10 miles	7½	6½	3	
Aug. 1, 1895	John Felter	2⅝ miles	5	3	2	320 acres.
Jan. 13, 1896	Jno. Cunnington, sr.	2,400 feet	3	2	1	85 acres.
July 13, 1895	Sarah Ann Faulkner	1.05 miles	3	2½	1	Do.
Feb. 6, 1896	Wm. C. Cunnington	1 mile	3	2	1	200 acres.
May 14, 1896	Geo. Durnford, jr	½ mile	4	3	1	85 acres.
May 18, 1896	John Bruce	¼ mile	4	3	1	55 acres.
Nov. 2, 1896	Laban Heward	1½ miles	4	3	1	66 acres.
Mar. 20, 1897	Wm. Longdon	¾ mile	5	4	2	40 acres.
May 31, 1897	Zebulon P. Dickey et al	8 miles	8	6	2	1,280 acres.
July 12, 1897	John A. McGraw	700 feet	8	7	1	440 acres.
Sept. 9, 1897	Thos. S. Johnston	1 mile	2	1½	1	90 acres.
May 24, 1897	Mattie Lyndon	⅝ mile	3	2	1	7 acres.
Nov. 17, 1897	Peter Dauks	½ mile	3½	2⅔	1	19 acres.
Feb. 3, 1898	Jos. B. Coffman	1 mile	5	3	1	180 acres.
Feb. 19, 1892	R. C. Chambers	8½ miles	24	18	4	10,088 acres.
May 24, 1897	Chas. Todd	270 feet	1½	1	1	30 acres.
June 30, 1892	Mary Lamon	2½ miles	6	5	1	80 acres.
Aug. 31, 1897	R. C. Chambers	36 miles	36	24	6	47,680 acres.
Oct. 13, 1898	Thos. Blyth	1,284 feet	3	25	1	26 acres.
Do	do	1 mile	4	3	1½	48 acres.
June 27, 1898	Laban Heward	1½ miles	5	4	1	66 acres.
July 9, 1898	Joseph Bird	15 miles	11	7	2	2,732 acres.
May 22, 1899	Thos. Cowlishaw	7 miles	6	4	1½	300 acres.

THE IRRIGATED AND IRRIGABLE LANDS.

The area which Bear River can be made to reclaim is restricted. On the upper third of the stream the alluvial valleys along the river have nearly all been irrigated. Further extensions will require larger and costlier works and the building of ditches to irrigate land along other streams, like the projects for irrigating the Hilliard Flats and the valley of Yellow Creek. In Idaho the land which can be profitably watered is limited in extent, and much of it is too uneven in surface to be attractive to irrigators. The greatest expanse of unoccupied land and the field of future growth is in Utah. Both in Salt Lake Valley, under the Bear River Canal, and in Cache and Gentile valleys, under projected canals, there is destined to be a great increase in the cultivated area.

The following table gives a close approximation to the reclaimed and reclaimable area in each State:

Irrigated and irrigable areas in Wyoming, Utah, and Idaho.

State.	Land irrigated.	Land yet to be reclaimed.	Total capable of being irrigated.
	Acres.	*Acres.*	*Acres.*
Wyoming	19,840	23,840	43,680
Utah	56,000	207,000	263,000
Idaho	16,000	*a* 10,000	26,000
Total	91,840	240,840	332,680

a Estimated.

The scarcity experienced by the appropriators living between the head of the stream and the mouth of Smiths Fork has led to considerable uneasiness and to a desire for an interstate adjudication of priorities by appropriators below, but a study of all the conditions shows their fear of scarcity to be groundless. Smiths Fork and Logan River are the principal sources of supply, and both reenforce the stream below where the greatest use now occurs. Three hundred and thirty thousand acres is believed to embrace all the land which can be profitably watered. The mean yearly flow of the stream for the past five years has been over 1,500,000 acre-feet. This would cover to a depth of nearly 5 feet all the lands which can be irrigated. One-half that amount will be ample. The immense size of Bear Lake, and the ease and cheapness with which it can be converted into a reservoir, make it possible to utilize practically all the water discharged from the stream except that flowing from Logan River. All that is needed is its conversion into a storage basin and the building of a canal from Bear River to fill it.

The irrigators along the Wyoming and Utah boundary need relief. During the past six years there have been a number of seasons when the stream was drained as dry as it was in 1898, when only defective dams prevented a dry channel. The completion of the Hilliard Flats or Yellow Creek Canal will either rob existing users below or lead to some sort of an agreement for the establishment and enforcement of priorities across State lines. The problems which will have to be solved before an interstate settlement of priorities can be had will be discussed in the succeeding pages of this bulletin.

INTERSTATE WATER RIGHTS IN BEAR RIVER.

By Joseph A. Breckons.

INTRODUCTION.

IMPORTANCE OF IRRIGATION.

The agricultural interests of fifteen States and Territories of the West depend directly and almost entirely upon irrigation and irrigation methods. These States and Territories (California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, North Dakota, South Dakota, Utah, Oregon, Wyoming, Arizona, New Mexico, and Oklahoma) comprise an area of 1,465,000 square miles, almost one half the area of the United States, and support a population of nearly six millions of people.

To the agricultural interests may be added the live-stock interests of these States and Territories, for, almost universally in the West, the live-stock interests are becoming merged with those of agriculture. Indirectly all of the great commercial interests of this vast region—great enough in extent, variety of resources, and population to be well termed an empire—are dependent upon the successful application of irrigation.

In this vast empire of the West water is the one essential element of all productiveness and consequent prosperity. Its use for mining operations first attracted attention, and was the subject of such legislation as made it applicable to mining matters. Its use for agricultural purposes of every kind has become far more important and beneficial, and more closely connected with the welfare of the communities of the West. Regions which were sterile and barren have, with the application of irrigation, been turned into gardens and made to blossom as the rose. Other regions, great in area and in latent possibilities, await the awakening touch of the magical, life-giving waters. The fountain of perpetual youth, in search of which the romantic Spaniard gave up his life when the century was young, has been found by the practical agriculturist of the West, and the dead plains and deserts, the barren valleys, the uplands and hillsides, for centuries covered with the shroud of sagebrush and greasewood, are now alive with the beneficent fruits made possible by the life-giving waters.

While wonders have been worked in the desert places of the West by means of irrigation, the results are infinitesimal compared with what remains to be accomplished by the full and complete utilization of the

resources which nature has placed at our disposal. The results already obtained have been secured by haphazard methods, lacking in uniformity and system. No interest of the West should be fostered by more careful legislation, based upon full and accurate information of conditions; yet none has more uncertain, unsettled, or unsatisfactory laws. The interests of the agriculturists of the West are in the main similar, and yet laws and methods relating to irrigation are as diverse in character in adjoining States as if the two Commonwealths were on different sides of the globe. The subject demands careful and complete legislation, which shall define the rights of all interested parties and establish a code of rules regulating them upon a comprehensive and just basis, and which shall establish uniformity in all of the irrigated region of the continent without reference to the artificial lines of State boundaries.

INTERSTATE CONTROVERSIES.

Under the present diverse treatment of irrigation matters by the several States and Territories of the irrigation region, the lack of legislation in one State, the radical difference between neighboring States in determining and adjudicating water rights, the too liberal appropriation of waters by some, and the general tendency of the residents of one State to disregard the rights of the citizens of another, all tend toward preventing the full utilization of the waters of the West, and toward depriving countless citizens of the full enjoyment of rights which, under a proper adjustment, they could have without prejudice to others.

This is not a theory, but an unfortunate condition obtaining in many portions of the West. Hundreds of streams have users of water on different sides of State lines, and the rights of the residents of one or the other of these States are frequently infringed by their neighbors across the State line. A recourse to the courts in such cases is expensive and troublesome and the litigation complex and lengthy. It can readily be seen what endless confusion would result were methods of determining land ownership, or ownership of personal property, placed upon such an uncertain and shifting footing as is the ownership of water. Uniform laws and similar methods determine all rights of real and personal property. The land laws of the several States are national and general in character, while in the West, for the waters which make these lands valuable, methods for the determination of water ownership and rights are widely different across State lines. Some States have elaborate systems of irrigation legislation, while others are almost devoid of legislation upon the subject.

NEED OF UNIFORM IRRIGATION LAWS.

The situation is, however, not wholly discouraging. Irrigation is yet in its primitive state in many portions of the West. It has been

an experiment and has not settled into definite lines that can not be changed. The chaos that exists is not an unmixed evil, in that it is so apparent that reform is suggested by its prominence. The value of water is becoming so apparent to all that none disputes the desirability of utilizing the full capacity of every stream, river, lake, and water course. All are beginning to recognize that this can only be effected by uniform legislation, by the accurate determination of the greatest duty of water, by its fair division, by the selection of suitable crops for certain altitudes, latitudes, and longitudes—in short, by making irrigation an exact science and by protecting all of its beneficiaries by uniform and just laws.

When this is accomplished the full beneficial use of the water and land of the West will have been secured and the rights of the people to both will be protected; litigation over irrigation rights, now threatening to overrun the courts, will be reduced to a minimum, and interstate quarrels, now imminent, will have their cause removed. Such a consummation is a possibility. The same general principles underlie and apply to the use of water for irrigation purposes in all parts of the West. Right to the use of water by virtue of prior appropriation and the necessity of devoting water to beneficial uses in order to obtain ownership are generally recognized as underlying principles of irriga tion law in the West, and it needs but uniformity of legislation, uniformity of executive methods, and uniformity of details of procedure in acquiring water ownership to secure equality of rights and the full utilization of the resources provided by nature.

ABROGATION OF RIPARIAN RIGHTS.

It was early determined in the West that the common-law doctrine concerning the use of water of natural sources which had been recognized and enforced by the courts both in this country and in England for centuries was not applicable to conditions where either mining or agriculture by irrigation formed the chief industries. The common-law doctrine is that the water of permanent running streams and of inland lakes is sacred to the common use alike of all riparian proprietors upon their borders. The doctrine extends to navigable and unnavigable streams and lakes which are wholly inland and territorial. Under this doctrine each proprietor may use the water for all reasonable purposes as it passes through or by his land, but he must, after its use, return it without substantial diminution in quantity or change in quality to its bed or channel before it leaves his own land, so that it will reach his adjacent proprietor in its full, original, and natural condition. Priority of use or appropriation by any one proprietor can give him, under this doctrine, no higher or more extensive rights than these. He has no property in the water itself, but simply the use of it while it passes along. He can not detain it or give it another direction, and he must return it to its ordinary channel when it leaves his estate.

The common-law doctrine, if applied to mining and irrigation, would almost wholly preclude these pursuits. This was recognized in the early history of the mining camps in the placer regions of California. Remote from the operations of law, customs and usages in reference to water, wholly at variance with the venerable tradition of the common law, came into use, and were adopted and enforced with rigor by the miners. They had thus a distinct creation, although, unknown to these people, a precedent existed in the old Roman law, which in all irrigated regions did not recognize the doctrine of riparian rights. The legislature of California in 1851 gave to these usages and regulations legal efficacy by enacting that "the customs, usages, or regulations, established or in force at the bar or diggings embracing said claims, and such customs, usages, or regulations when not in conflict with the constitution and laws of this State, shall govern the decision of the action." These mining customs or rules were simple, and related to the acquisition of "claims" to mineral land and to water for the purpose of mining, and prescribed the acts necessary to constitute such an appropriation of a parcel of mineral land or portion of a stream as should give the claimant a prior right against all others. In this is the origin of the doctrine of water rights as settled in the Western communities. Water was an indispensable requisite for carrying on mining operations; a permanent right to use certain amounts of water was as essential as the permanent right to occupy a certain parcel of mineral land. The streams and lakes were all on the public domain. It was often necessary to divert water from its natural bed or course. From all these circumstances, and from the very necessities of the situation, it became one of the mining customs or regulations that the right to use a definite quantity of water, and to divert it if necessary from these streams and lakes, could be acquired by appropriation.

This custom was soon approved by the courts, and the doctrine became settled in the Western States, in opposition to the common law, that a permanent property in the water of streams and inland lakes upon the public lands of the United States may be acquired for mining purposes by mere appropriation; that an appropriator may thus acquire the right to divert, use, and consume a quantity of water from the natural flow of streams which may be necessary for the purposes of his mining operations; and that he becomes, so far as he has thus made an actual appropriation, the owner of the water against all the world except the United States Government. This doctrine, applied at first to the operations of mining, was found equally applicable to agricultural interests, and has been extended to this and all other beneficial purposes for which water may be essential.

The right of property in water thus settled by the State courts availed

against all persons excepting the United States Government. This limitation was soon removed. Congress, by the act of July 26, 1866, recognized a right to water on the public domain, acquired by prior appropriation, as a substantial and valid right which the Government was bound to acknowledge and protect. The statute has been held by the United States Supreme Court to be "a voluntary recognition of a preexisting right of possession, constituting a valid claim to its continued use."

PRINCIPLES WHICH GOVERN APPROPRIATIONS OF WATER.

From the foregoing it may therefore be stated that the principles governing the use of water may be briefly summed up as follows: While a natural stream or lake is situated on the public lands of the United States, within the limits of a State, a person may, under the customs and laws of a State and the legislation of Congress, acquire by appropriation the right to use the waters thereof for beneficial uses, and to construct reservoirs and ditches over and upon the public land. When such a right has been acquired by prior appropriation, subsequent grantees of the public domain bordering upon the same stream or lake, homestead settlers and all other purchasers, take and hold their titles subject thereto.

Upon this basis there may be built, by the exercise of intelligent and practical action, a comprehensive system of exact irrigation jurisprudence applicable to the entire area of the West in which irrigation is a necessity or benefit. With this principle kept in view before the regulations and methods of the several States become irrevocably fixed, there may be established uniformity in methods of appropriation; uniformity in the executive administration of water laws; customs, now conflicting in neighboring States, may be harmonized; a general and equitable standard of the duty of water established, and irrigation laws, instead of varying with every arid commonwealth, may be as uniform, simple, and as easily understood as those governing the ownership of land.

INTERSTATE WATER RIGHT CONTROVERSIES.

The controversies which already exist between the water users of adjoining States are many, and with the continuous increase in the use of water these controversies bid fair to become so numerous as to burden the courts with their settlement. Controversies of this nature now exist between citizens of Wyoming and Nebraska, Wyoming and Colorado, Wyoming and Utah, Wyoming and Idaho, Wyoming and Montana, Colorado and Kansas, Colorado and New Mexico, and in fact between the citizens of all contiguous States and Territories in the irrigated regions of the West.

These controversies are assuming State importance. The last Wyoming legislature appropriated funds to sustain a suit against Colorado

appropriators of water from streams flowing from Colorado into Wyoming, which it is claimed they are unlawfully diverting. The last legislature of Kansas authorized the counties of that State to appropriate funds to protect in the courts the rights of Kansas irrigators to the water of streams flowing into Kansas from Colorado. The Territorial legislature of New Mexico has appointed a commission to investigate the question of water supply for irrigation purposes, with a view to protecting the interests of the irrigators of New Mexico.

To take up and discuss this endless list of controversies in all of the diverse conditions of the different interstate flowing streams would make a bulletin too complex for general use or information. One stream only will therefore be discussed, and one has been selected which presents within itself examples of these controversies in concrete form. This is the Bear River, a stream which rises in Utah, crosses the southwest corner of Wyoming, returns to Utah, returns again to Wyoming, leaves Wyoming and enters Idaho, where it makes an abrupt loop, returning again to Utah, where it empties into Great Salt Lake at a point but little over 100 miles from its source.

In all of the States traversed by this river the settlers along its course are drawing on a common source for water for irrigation purposes; in all is recognized the doctrine of the right to use of water by virtue of prior appropriation, and the settlers are calling upon their respective commonwealths to protect that right. Yet, because these rights have thus far been left to the settlement of State tribunals which only exercise jurisdiction within State boundaries and have no influence beyond, over 250 distinct appropriations, one representing an outlay of $1,000,000, are as absolutely without specific regulation as if there were no irrigation laws. And while it is true that the courts may in time be invoked in litigation, yet a decision regarding priorities across State lines will not open head gates across State lines when the stream rises enough to give water for all or close them when water is scarce. That needs an officer with specific duties. It would be just as easy to conduct a city water plant without an engineer to run the pump as to try to enforce priorities across State lines without some authorized official to open and close gates. There is now no United States or State law to correct this need.

Some Wyoming irrigators along the stream have taken advantage of these conditions, and in order to avoid the enforcement of priorities in Wyoming have built the head gates of their ditches just across the State line in Utah.

DIFFERENCE BETWEEN WATER-RIGHT RECORDS IN STATES CONCERNED.

A great many of the irrigators who are taking water from this stream and experiencing this unsatisfactory condition of affairs have called for a remedy, and have urged a division and adjudication of the

waters of the entire stream. But when authority is sought to make such a study of the stream as is necessary for such a division and adjudication it is found that there must be some legislation to bring the rights of the irrigators and the methods of enforcing them into harmony.

Some perplexing problems will have to be solved before such division and adjudication as suggested can be effected. All agree that priority of appropriation and devotion of water so appropriated to beneficial use establishes the right of the appropriator. But before there can be any division of the waters on a just basis it must be known when and how the rights of the individual appropriators were acquired.

In commencing to make such division the following situation would be confronted:

In Wyoming certain requirements in reference to recording ditches are observed. An examination of the official records of a body established by State law and known as the State board of control will disclose the date of appropriation, the object, and the amount of water to which the appropriator is entitled.

In Utah there is no general record of such rights and no common place of record. Whatever records there are in Utah of rights acquired prior to the passage of the law of 1897 are voluntary ones, made by appropriators with county officers. There is no examination by authorized officials to determine if the records are in accord with facts, and such records as are made do not always give a correct and complete history of the existing situation. The Utah records of the Bear River appropriations are scattered among four counties, and in order to determine the status of contiguous water users at various places on the stream all of the four county seats must be visited.

The second State legislature of Utah passed an act requiring that all persons intending to construct irrigation works must post a notice at the head gate and record a statement of claim in the office of the county clerk. The same act also provides for the recording of claims existing at the time of its passage. This clause was made inoperative by the following proviso: "That a failure to comply with the requirements of this section shall in no wise work a forfeiture of such heretofore acquired rights or prevent any such claimant from establishing such rights in the courts." By reference to the map it may be seen that even though the records of Utah were faithfully kept they would do no good above Bear Lake, because Idaho intervenes.

In Idaho the situation is somewhat similar to that in Utah. The records of appropriations are in the several counties and are subject to no general rule as to form and method of keeping. The recorded claims differ in various counties as to the unit of measure employed, and the amount of water claimed depends largely upon the desires of the claimant. There is no system of adjudication or record employed in the State, and there is general complaint that no one can enjoy the

ownership of water sufficient to render his farm permanently productive until his rights have been tested by lawsuits. The records become encumbered with imperfect water-right locations, many of the papers recorded failing to state necessary facts to constitute an intelligible record. The records, being in the various county seats, are widely scattered, and the failure to require any submission of proof of compliance with the law after the recording of the notices of claim renders the records useless for the purpose of determination of perfected appropriations.

DIFFERENCE IN CHARACTER OF RIGHTS.

It may therefore be readily seen that at the outset the claims of appropriators of water from the Bear River on record could not be taken as a basis for the equitable division of its waters.

If an effort should be made to go further and to determine what the actual rights of the people are who are using the waters of the stream, the first step would be the establishment of a standard by which these rights might be measured. If a right be determined by the size of the ditch built by the Idaho appropriator, this should also determine the rights of the appropriators in the other two States. If it is determined in Wyoming by the acreage which has been irrigated, or the needs of that acreage, the same standard should be employed in Idaho and Utah. There could never be a harmonious and just division of the waters of the stream across State lines, no matter by what authority divided, if in Wyoming rights should continue to be measured by the acreage irrigated, and in Idaho and Utah such rights should be measured by the size of the ditch whether any acreage is irrigated or not. As a matter of fact, an examination of the irrigation statutes of these three States will show that the laws of Wyoming do not recognize any but usufructory rights, and the water appropriated for irrigation is measured by the acreage upon which it is to be used and the necessities of that acreage. While not settled by the courts of last resort of the State, so far as the administration of the irrigation laws is concerned ownership of water is held to be inseparable from that of the land to which it appertains. In Utah rights to water can be acquired for purposes of sale, and water is declared by statute to be personal property. The courts of the State have held that water ownership can be separated from land ownership, and thus it is made a separate or floating right. In Idaho there has been no settlement of these matters, and there is no degree of certainty as to what a water right really is, or whether once acquired it is attachable to any part of the land it is desired to water, or is movable at will up or down stream.

DIFFERENCE IN TRIBUNALS WHICH DETERMINE RIGHTS.

If an attempt should be made to divide the waters of the Bear River equitably, regardless of State boundary lines and upon a common standard of measurement, such division would have to be made by a

tribunal which should establish and adjudicate the various rights in accordance with the laws of the respective States through and in which the waters of the stream flow. Could such a tribunal be agreed upon is a doubtful question.

In Wyoming the executive authority for dividing and adjudicating the waters of the river is the State board of control, a member of which collects the testimony of all who use the waters of the stream, obtaining facts as to dates of construction of ditches, size of ditches, time of first appropriation by each user, and acreage irrigated by each, and the waters are divided as equitably as may be possible with this information as the basis for making the division.

In Utah there is no tribunal by which the waters of the stream may be divided other than the courts, and rights are determined by an ordinary suit at law between claimants.

In Idaho, if a dispute arises, the courts must be appealed to for a division of water among irrigators.

In order to effect a satisfactory division, the tribunal making it must meet the ideas and prejudices of the people to be governed by its decisions, and in all the steps to be effected their views must be conformed to in as large a degree as possible. With the records of priorities and amounts of appropriations at hand, and with a uniform standard of measurement established, the question still remains: Is it feasible to get the people of the several States to agree upon any uniform method of supervision?

As conditions now exist, with water users working out these various problems within the borders of their own States, and the methods and forms of procedure of these States far apart in irrigation matters, the efforts to draw them closer together will necessarily work injury to some individuals. The number injured, however, will certainly be smaller if the efforts are made in the immediate future than if put off to some distant date.

EVILS OF LITIGATION OVER WATER RIGHTS.

No case involving contests between residents of adjoining States for the right to use the waters of a stream flowing in or through both States has as yet reached ultimate and final decision in the courts. This is due in a measure to the fact that such litigation is extremely expensive, tedious, and vexatious, involving a final appeal to the United States Supreme Court; that the pioneers in irrigation have been generally settlers of small means, who have preferred submitting to injustice rather than become involved in legal controversies likely to absorb a goodly portion of their belongings; and that the absence of irrigation laws in many of the irrigated States has given license to might rather than right in the settlement of water-rights controversies. Even States the interests of whose citizens have been encroached upon by the citizens of adjoining States have been slow to plunge into legal controversies, and have allowed their citizens to suffer without an effort to afford them the protection to which they should be entitled.

This state of affairs, it is self-evident, can not continue much longer. The rapidly increasing importance of irrigation interests, the necessity of securing the greatest service from the waters of all streams, and the need of protection for vested rights, all tend to make it imperative that a remedy must soon be found either in the courts or in the State or National legislatures.

CASE OF HOWELL v. JOHNSON.

The extent to which settlement of interstate rights to water has been reached by the courts is found in the case of Howell *v.* Johnson et al. (89 Fed., 556), in which a decision was recently rendered in the United States circuit court for the district of Montana by Hon. Hiram Knowles, district judge.

The decision is as follows:

The plaintiff is a citizen of the State of Wyoming. The defendants are all citizens of the State of Montana. In his bill of complaint the plaintiff sets forth that he is the owner of certain lands in the State of Wyoming, and that, for the purposes of irrigating the same, he appropriated certain waters of a creek called "Sage Creek." This creek has its sources in Montana, and flows for some distance within its boundaries before it enters the State of Wyoming. Plaintiff's ditch and point of diversion of said waters are both within the last-named State. Defendants settled along the line of said creek, in Montana, subsequent to the appropriation of plaintiff, and in said State have diverted, it is alleged, the waters of the said creek, and prevented the same from flowing down to plaintiff's ditch and land. Plaintiff has sued defendants in this court, and asks to have them enjoined from so diverting said waters. Defendants have filed a demurrer to this bill.

The points presented in this demurrer are that plaintiff, having a water right acquired under and by virtue of the laws of Wyoming, can not come into this court to enforce the same. It is also claimed that the rights pertaining to this water are under the control of the legislative power of Montana.

Considering the first point, it is urged that the right of plaintiff, being acquired under and by virtue of the laws of the State of Wyoming, can be enforced only as to citizens of Wyoming, and not against citizens of Montana, who have diverted water only in Montana. Is the right claimed by plaintiff one which accrues only by virtue of the laws of Wyoming? Plaintiff alleges that he made his appropriation of the waters of said creek in accordance with the laws of Wyoming and Montana. Allowing that there could be no appropriation of the waters of said creek made in Wyoming under or by virtue of the laws of Montana, still the allegation that the appropriation was made under the laws of Wyoming remains. According to the bill plaintiff's appropriation was made on the 1st day of August, 1890. At that date sections 2339 and 2340 of the Revised Statutes were in force. They provided:

"Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage. All patents granted, or preemption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights, as may have been acquired under or recognized by the preceding section."

In the case of Basey *v.* Gallagher (20 Wall., 670), the Supreme Court said in regard to this act: "The act of Congress of 1866 recognized the right to water by prior appropriation for agricultural and manufacturing purposes as well as mining;" and also decided that if the right to appropriate water for any of the purposes named was recognized by either local customs, or by the legislation of any State or Territory, or by the decisions of the court, it would be sufficient. The allegation in the bill that the water was appropriated under the laws of the State of Wyoming would meet the requirements of the said act of Congress. Up to the passage of the said act of 1866, the right of the prior appropriator to use water, for any of the purposes above named, had, in the arid and mining regions of the West, been recognized as against any other person claiming the same, but not as against the National Government. This act, coupled with the act of July 9, 1870, embodied in said section 2340, recognized the right of the prior appropriator of water upon the public domain, even as against the United States and its grantees, if said appropriation was authorized by the statute of the State where the appropriation was made. (Black's Pom. Water Rights, No. 25; Osgood *v.* Mining Co., 56 Cal., 571.) The rights of the plaintiff do not, therefore, rest upon the laws of Wyoming, but upon the laws of Congress.

The legislative enactment of Wyoming was only a condition which brought the law of Congress into force. The National Government is the proprietor and owner of all the land in Wyoming and Montana which it has not sold or granted to some one competent to take and hold the same. Being the owner of these lands, it has the power to sell or dispose of any estate therein or any part thereof. The water in an unnavigable stream flowing over the public domain is a part thereof, and the National Government can sell or grant the same, or the use thereof, separate from the rest of the estate, under such conditions as may to it seem proper.

In Black's Pom. Water Rights, No. 32, it is said:

"As the Federal Government, in conveying any particular portion of its public domain within a State to a particular grantor, may, as proprietor, annex any condition to the conveyance so that the title will be taken and held subject thereto, so it may, by Congressional legislation, adopt any general conditions upon the use of the public domain to all persons, or upon all persons, who acquire title to portions of the public domain from the Government, and the title so acquired will be held by the grantees thereof, subject to such conditions and limitations. Thus, Congress may provide by general statute for a right of way over the public lands unsold for the ditches and canals of those who have made a prior appropriation of water, and that all grantees who subsequently acquire portions of this land shall take and hold their titles subject to such existing right of way, or that all grantees of public lands bordering upon a stream shall take and hold their titles subject to any previously existing appropriation of its waters."

These views are supported by the case of Mining Co. *v.* Ferris, 2 Sawy., 176, Fed. Cas. No. 14371.

The Federal Government is not restrained in the disposal of its lands by State laws or State lines. Its laws upon this subject apply to the lands in one State as well as another. It has made grants of land extending through several States. The State governments can not restrict it in the primary disposal of its lands. If it may sell and dispose of its land as it may deem proper, there is no reason why it may not sell a part thereof as incident thereto, such as the use of water flowing over the same. That it has the same right as any real estate proprietor would be self-evident. It is apparent, then, according to the allegations of the bill, that plaintiff acquired rights by appropriation in Sage Creek to which all who have acquired lands upon the same, or water rights therein, subject to his appropriation, must be subordinate. His rights have the sanction of the Federal Government.

It is urged that in some way the State of Montana has some right in these waters in Sage Creek or some control over the same. It never purchased them; it never owned them. In support of this view, the court is cited to a great many decisions which apply to navigable rivers and lakes and tide waters. Here we approach a

different subject. There is no claim that Sage Creek is a navigable stream. A State, upon its admission into the Union, acquires, by virtue of its sovereign powers, the title to the beds of all navigable rivers, lakes, and tide waters within its boundaries, subject, however, to its rights of commerce and navigation. This title gives it, to some extent, a control over the waters of such rivers and lakes and the power to establish and determine what shall be the riparian rights which shall pertain to those who hold the title to lands bordering on the same. The case of St. Anthony Falls Water Power Company *v.* Board of Water Commissioners of St. Paul, decided November 29, 1897, by the Supreme Court (18 Sup. Ct., 157), was one which pertained to the rights of the plaintiff in that case as the owner of lands upon the borders or banks of the Mississippi River. This river was held to be a navigable stream, and all of the rights of the State of Minnesota grew out of that fact. In that case it was held that the riparian rights of the owner of land bounded by any navigable river depended upon the laws of the State where such land was located. In that case it was not held, nor was it held in any of the cases cited in the decision therein, that the rights of the owner of the land through which any innavigable stream flowed within the boundaries of any State depended upon the laws of such State, or that the said owner's right to such water depended upon such laws, as against one who claimed a right to the same under the laws of Congress. To so hold would uphold the view that a State might interfere with the primary disposal of the land of the Federal Government. When a party has obtained title to property from the National Government, the State government has no right to destroy that title, except under the power of eminent domain. The State of Montana can not step in and say, "The right to the water of Sage Creek, which the plaintiff acquired under the laws of Congress, you can not exercise in this State." This would be the taking of the plaintiff's property from him without due process of law. It is a recognized rule of law that a person who has appropriated water at a certain point in a stream is entitled to have so much of the waters of said stream as he appropriated flow down to him to the point of his diversion. The defendants, according to the allegations in the bill, are violating this rule, and should be enjoined.

The idea that there can arise any international water-right question in the case of the waters of an innavigable stream can not be maintained. The right to such waters, after the National Government has disposed of them, must always be a private question. For these reasons the demurrer in this case is overruled.

The correctness of the reasons upon which the decision is based in this case is denied by many lawyers in the West who have given much attention to water-right law. In the case (cited above) of Basey *v.* Gallagher (20 Wall., 671) Mr. Justice Field, of the United States Supreme Court, stated:

> The act of Congress of 1866 recognizes the right of water by prior appropriation for agricultural and manufacturing purposes as well as for mining. * * * It is evident that Congress intended, although the language used is not happy, to recognize as valid the customary law with respect to the use of water, which had grown up among the occupants of the public land under the peculiar necessities of their condition.

The constitution of the State of Wyoming, Article No. VIII, section 1, declares: "The water of all natural streams, springs, lakes, or other collections of still water, within the boundaries of the State, are hereby declared to be the property of the State," and the act of Congress, approved July 10, 1890, admitting the Territory of Wyoming to statehood, accepted, ratified, and confirmed this constitution as being "republican in form and is in conformity with the Constitution of the United States."

The complete recognition of the principles which Judges Knowles lays down as the reasons for his decision in this case would mean the total disorganization of existing systems in the irrigated States, the overturning of constitutional rights, and the reversal of the decisions of the courts which have held generally that Congress, by the act of 1866, has surrendered sovereign proprietorship in the waters of natural streams.

NEED OF CLOSER APPROACH TO UNIFORMITY IN STATE LAWS.

That an undesirable, deplorable, and even dangerous state of affairs, in reference to water rights along interstate streams, exists in the irrigated regions of the West by reason of diverse, nonuniform, and incomplete irrigation legislation is evident. That this state of affairs if not improved will become, by reason of the rapidly enlarging number of individuals and the increasing value of interests affected, more undesirable, more deplorable, and more dangerous, is absolutely certain. It is also certain that a continuation of present conditions will retard the growth of irrigation interests, render property the value of which depends upon irrigation less valuable by reason of the uncertain tenure and instability of water rights, and will be generally detrimental to the welfare of the people of the West, vitally interested as they are in proper and equitable irrigation laws.

Thinking men, devoted to the work of securing for the West permanent welfare and prosperity, seek a remedy which shall improve the present unsatisfactory conditions in this great factor of Western development. Whether a practical remedy can be found and made effective so as to secure desired results is a question hard of solution. In the establishment of law and rules of society individual natural rights are relinquished voluntarily in order that a measure of uniformity may be reached by which all may be benefited and protected, and all legislation under forms of self-government carries with it the idea of sacrifice upon the part of the governed in order to make such legislation effective. To establish uniform irrigation laws which shall apply to the entire arid West, the rights of many individuals which have been secured by reason of too liberal provisions of the laws of the State in which they happen to reside, or by the absence of all irrigation laws, or through other causes, would doubtless be encroached upon by the formation of a general system which might demand concessions from one State to meet the requirements of an adjoining one. In fact there might and doubtless would be entire communities called upon to make sacrifices in order to establish a general law or system for the good of all. But the number of persons who might suffer at this time, or at some time in the immediate future, by reason of changes which might be necessary in the laws of the State in which they live, is infinitely small compared with the number who suffer from the imperfections of the present system, or with the number who would have to make concessions from acquired rights should action in this direction be deferred for any con-

siderable time. Consequently the earlier an earnest effort is made to effect a radical change in the direction of reform and toward the establishment of a general system of water-rights law in the irrigated regions of the country the less opposition is likely to be encountered from individuals, communities, or States; and the earlier action is taken the less the friction will be from the ensuing changes.

NATIONAL LEGISLATION.

An adequate remedy through national legislation, it is to be feared, is out of the question. The General Government, by act of Congress of July 26, 1866, formally withdrew from interference with local customs, laws and decisions of courts relative to the use of the waters of nonnavigable streams. The Territories admitted to statehood subsequent to that act have embodied its general provisions in their constitutions, which have been approved by Congress by the terms of the various acts of admission. Any general legislation by the National Congress relative to water rights would mean an upheaval too great and too far-reaching to be practical. It would mean that a number of the States would have to make changes, not only in their laws, but in their constitutions, and would overturn the long line of established practice and decisions of the courts in dealing with this question.

The waters of natural streams within the boundaries of the several States in the irrigated regions being, by virtue of constitutional provision, by the abandonment of control by the General Government, or by usage or the decisions of courts, the sole property and under exclusive control of these States, it is clear that reform of evils which exist by reason of defective legislation in these States, or by reason of lack of all legislation, can only be effected by proper legislation on the part of the legislative branch of the governments of these States. It is clear, too, that reform can not be effected unless the several States, in forming new legislation or correcting that which already exists, take into consideration the rights of the citizens of neighboring States as well as the rights of their own people. No uniformity can be secured if legislation continues in the future, as in the past, to be enacted for the benefit of individuals or local communities and not of such general nature as to make it applicable to the great body of irrigators of the entire area of irrigated lands.

Reform in this matter can not well be accomplished by arbitrary action upon the part of State governments, but must be accompanied by an educational movement which will convince irrigators that proposed legislative changes are practicable and desirable.

CONVENTION TO CONSIDER UNIFORM LAWS.

As reform must in the main come from the voluntary action of the States, and as it is, without much question, the general desire of the residents of the irrigated regions of the West that some such plan of

voluntary legislative procedure be tried in order that reform in this important matter may be secured, a plan is suggested, which, if adopted, may be the means of consummating uniformity of legislation upon water-right questions in the West. It is that the governor of each State and Territory in the irrigated region appoint two commissioners, one to be the State or Territorial engineer, or the officer whose position most closely conforms to that of State engineer, and one practical irrigator, engaged in irrigation. The commissioners to meet at some convenient place within six months from the time of their appointment and formulate a system of irrigation laws for each State and Territory so represented, conforming as closely as may be possible to a general code, varying from this to meet local conditions where necessary; the system adopted for each State to embody general and uniform methods of recording, a general standard of measurement of water rights, and general provisions providing for adjudication of the waters of interstate streams; and the system so adopted to be submitted to the legislatures of the various States and Territories at their next succeeding session, and recommended for adoption.

While the adoption of this plan might not be followed by immediate and complete reform in the matter of water-rights legislation, it might possibly be the stepping-stone to such reform. Annual congresses, such as the trans-Mississippi, the irrigation, and similar meetings, are held for the purpose of influencing national legislation upon matters of general interest to the West. It seems reasonable to suppose that the recommendations of a convention composed of practical irrigators and irrigation experts, upon a question of immediate and vital importance to every State and Territory within the irrigation district, would carry great weight with the lawmaking bodies of these States and Territories. It is possible that but few of the States would adopt the recommendations of such a convention, but a great advance will have been made in the direction of uniformity when any two contiguous States work upon similar lines, employ uniform methods, and provide for joint adjudication and apportionment of the waters of a stream common to both States.

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